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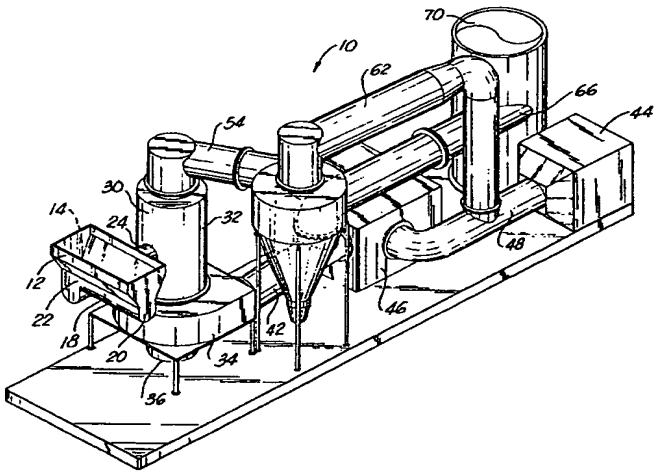
(54) Title: AIR MILL DRYING/GRINDING SYSTEM AND PROCESS



(57) Abstract: A system which employs cyclonic air action to induce the waste media drying of different waste products. The system includes a hopper (12) for introducing the waste product therein; the waste product is conveyed via an auger (16) to a mill (30) which has the capability of drying, grinding, and pulverizing the material through cyclonic action and the use of heated air, to produce a dry, solid product which is moved out of the system. The heated air from the cyclone is then returned to merge with a flow of heated air from a blower which is introduced into the mill. It is through this process that the system maintains a closed system, and the waste product is collected into a collection bin in a very fine dust-like material that can be safely stored or disposed of. There is further included an electro cell portion of the present invention wherein a reaction chamber is utilized for charging the waste particles in the system and separating the charged particles from the liquid in the system.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

PATENT APPLICATION

TITLE OF THE INVENTION

"Air Mill Drying/Grinding System and Process"

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CROSS-REFERENCE TO RELATED APPLICATIONS

Priority of US Patent Application Serial No. 09/399,070, filed 18 September 1999, incorporated herein by reference, is hereby claimed.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable

REFERENCE TO A "MICROFICHE APPENDIX"

Not applicable

BACKGROUND OF THE INVENTION

1. Field of the Invention

The system and process of the present invention relates to treatment of wastes. More particularly, the present system relates to the drying of waste material through the use of air, and for grinding the larger portions of the material prior to the drying process being undertaken.

2. General Background of the Invention

In the field of waste treatment, whether it be municipal waste, or other type of waste that occur naturally through processes undertaken, it is very beneficial that the treatment of the waste be undertaken in such a manner so as to produce a product that is not harmful to the environment. For example, at present, in the treatment of municipal waste, there is usually an elaborate waste system established whereby the raw sewerage is introduced into the system and treated with various chemicals or the like to precipitate some of the waste material. The fluid portion of the material is again treated and aerated so as to complete the treatment of the waste so that it may be safely dumped into a waterway or the like so as to not contaminate the water in the locality of the municipality. However, there are other types of wastes which must be treated which require that the treatment undertake an elaborate treatment process which is often time consuming and

expensive, and again may not produce the results that are completely beneficial and would continue to pose a harm to the environment.

The following U.S. Patents are incorporated herein by reference:

2,076,899
2,233,079
2,364,405
2,515,126
3,034,647
3,547,357
3,976,253
4,073,443
4,082,231
4,253,615
4,417,697
4,434,522
4,909,821
4,956,091
4,932,594
5,268,128
5,302,179
5,426,866
5,570,517
5,695,130
5,820,040
5,839,673
5,850,977.

BRIEF SUMMARY OF THE INVENTION

The process/system of the present invention solves the problems in the art in a simple and straight forward manner. What is provided is a system which employs cyclonic air action to induce the waste media drying of different waste products. The system includes a hopper for introducing the waste product therein; the waste product is conveyed via an auger to a mill containing a plurality of air veins which produces a

clockwise rotation of the product and which has the capability of drying, grinding and pulverizing the material through and the use of heated air, to produce a dry, solid product which is moved out of the mill. The fluidized material is then carried by the flow of hot air into a cyclone for separation from the heated air. The heated air from the cyclone is then returned to merge with a flow of heated air from a blower which is introduced into the mill. It is through this process that they system maintains a closed system, and the waste product is collected into a collection bin in a very fine dust-like material that can be safely stored or disposed of.

Therefore, it is a principal object of the present invention to provide a process for treating and drying waste materials with waste materials containing water so that the end product is completely dry and free of moisture;

It is a further object of the present invention to provide a process for grinding and separating waste materials at their natural boundaries to produce an environmentally safe product; it is a further object of the present invention to provide a waste material treatment process that is reliable, simple in operation, cost effective, and incorporates a closed system which is safer to the environment;

It is a further object of the present invention to provide an efficient drying process that can grind and dry waste products at a rate of up to 20 tons per hour such as orange pulp, animal waste, gypsum, sugar, plastic, drilling mud and other types of waste material;

It is a further object of the present invention to provide a waste treatment system which includes an electro cell component of the system for charging waste particles in such a manner that they may be separated from the liquid in the system.

BRIEF DESCRIPTION OF THE DRAWINGS

For a further understanding of the nature, objects, and advantages of the present invention, reference should be had to the following detailed description, read in conjunction with the following drawings, wherein like reference numerals denote like elements and wherein:

Figure 1 illustrates an overall perspective view of the preferred embodiment of the system of the present invention;

Figure 2 illustrates a flow chart incorporating the various components utilized in the preferred embodiment of the present invention;

Figure 3 illustrates an additional flow chart of the preferred embodiment of the of the present invention utilized in a municipal waste plant setting;

Figure 4 illustrates an overall view of the grinding tubes utilized in the present invention;

Figure 5 illustrates an exploded view of the grinding tubes utilized in the present invention;

Figure 6 illustrates a partial view of the relationship between the hopper/auger portion of the present invention as material is moved into the mill portion;

Figures 7-10 illustrate various views of a reaction chamber utilized in the electro cell portion of the present invention; and

Figures 11-17are additional views of the apparatus of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Figures 1-6 illustrate the preferred embodiment of the system of the present invention 10 which is utilized for carrying out the process of the present invention. As illustrated in the figures, reference is made particularly to figures 1 and 2, where there is illustrated first a hopper portion 12 which is open-ended at 14 for allowing waste products to be introduced therein within the hopper system 12. As seen more clearly in Figure 2, hopper system 12 includes a first auger member 16 contained within a lower portion 18 of the hopper 12 for moving waste product from a first end 20 of the hopper to a second end 22. The material is then dumped into a lower auger system 24 containing a bladed auger 26, of the type known in the art, for moving the product in the direction of arrow 28, as seen in Figure 2, along the auger channel 24 to be dumped into a mill 30. It is foreseen that the second lower auger 24 may comprise a heated auger having a series of heating elements built within the wall of the auger, and capable of producing at least 1,000°F of heat so that as the waste material contained within hopper 12 and moved along by first auger 16 is dumped into the second auger 24. By the time the waste material reaches mill 30, any moisture which may have been contained in the waste material has substantially been evaporated out of for the most part, leaving dry waste.

Discussing the system further, the waste product as was stated earlier, is dumped into the mill portion 30, which has an upright mill having a continuous side wall 32. The mill includes a plurality of air veins 33, preferably 20 veins, which

causes the air to start spinning in the mill in a clockwise rotation, and at a rate of approximately 490 miles per hour, thereby causing the solids to spin and separate at their natural boundaries. Also, the mill 30 is being heated at a maximum 400°F and preferably between 250 and 300°F in the optimum heating. The heated air enters the lower portion of the mill 30 through air shroud 34. There is further provided an electrical motor 36 which feeds into ~~and~~ a gear box 38, with the gear box 38 turning a plurality of scraper blades 39 in the mill 30 at approximately 94 rpms in order to prevent buildup on the interior of the mill walls. The mill has the ability to dry and pulverize a variety of materials contained therein for the most part, such as orange pulp, municipal sludge cake, animal waste, paper pulp, wood, gypsum, red mud, corn, sugar, plastic, and drilling mud. Of course, there are other items that can be separated but for purposes of example, these types of materials have been tested and found to be sufficiently processed for safe disposal after the process is completed through the system.

During the process of the present invention, the material which is dumped into the mill 30 will decay and disintegrate. While the material is being processed within the mill 30, heated air will be introduced at point 40 which will be transported via line 42. The air will be heated by a heater 44 which is pulled into the system via a blower 46 so that the heated air moves from the heater 44 via a first line 48 where blower 46 moves the heated air into line 42 and into the lower portion 32 of mill 30. The lower portion 32 comprises an air shroud 33, which houses a plurality of veins 35(phantom view) which increase the velocity of the hot air as it moves into mill 30.The material that is being ground within mill 30 is in a very fluid state and moves from the pressure zone at the lower portion of the mill 32 in the direction of arrow 50 to the upper portion 52 of mill 30 causing the particles of different size and specific gravity to constantly interact. The material is then directed by the turbulence of the hot air to the other air pressure boundaries and the grinding would then begin. The material grinds against itself and causes a constant breakdown. There is then a reaction by the material as if it were in a cyclone which causes a dramatic turbulent reaction. Swirls and eddies are created at extreme velocity with rotational action.

The hot air then moves the material via a line 54 into the cyclone 56 which is a typical type of a cyclone wherein the air and material is rotated at a high rate so that

the solid material drops to the bottom portion 58 of the cyclone and is then collected in bags or the like at point 60. The hot air moves via arrow 62 into a line 64 and is returned to be reintroduced at a point between the heater 44 and the blower 46. At this point, this air in line 64 will join the heated air 48 being sucked into the blower 46 and is then returned into the mill where the process continues on. In this manner, there is a closed system where the air continues to flow throughout the system and the dry product will be collected at 60. Should there be undue pressure within the system at any point, there is seen a release line 66 wherein the excess air is then moved into a scrubber 70 for maintaining the system in the correct pressure ranges. It is foreseen that in the mill portion 30 of the system, there will be particular type of sensors utilized so that the high and low pressure ranges within the mill 30 which enables the particles to break up into the finer material for later collection. The pressure ranges between the lower portion 32 of the mill and the upper portion 52 of the mill are carefully maintained within certain ranges so as to insure optimum operation of the system.

Reference is now made to individual components of the system, as seen in Figures 4-6. First, as seen in Figures 4 and 5, there may be incorporated the grinder 80 which is seen for example in Figure 4. Grinder 80 would be housed within the hopper 12, above the first auger 16. Grinder 80 would comprise as seen in exploded view in Figure 5, a first plate 82 rotated on a shaft 84. The inner face of plate 82 includes a plurality of spaced apart grinding tubes 86. Further, as seen in Figure 5, there is a second plate member 88 which has on its inner face a plurality of grinding tubes 86 with the plate 88 being slightly smaller in diameter than plate 82, so that the grinding tubes 86 on plate 88 fit within the interior space 90 created by the circular pattern of the grinding tubes 88 on plate 82. There is likewise found a shaft 84 which rotates smaller plate 88. As further noted in Figure 5, large plate rotates in a first direction in the direction of arrow 92 and smaller plate 88 rotates in the opposite direction as seen by arrow 94.

Returning now to Figure 4, there is illustrated the first grinding plate 82 with grinding tubes 86 which has been merged together with smaller grinding plate 88 likewise having grinding tubes 86. As seen in that pattern with the two plates rotating in opposite direction via shaft 84, there is created a spacial relationship between the

tubes 86 so that large chunks of waste material 96 as seen in Figure 4 as it encounters the tubes moving in opposite direction is finely ground into the smaller material 98 as seen in Figure 4. Therefore, by the time the small material 98 would then fall into the first auger 16 and be transported into second lower auger 24, where it is then heated, dried and conveyed into the mill 30.

Turning now to Figure 6, this process is seen where the material is moved by the auger blade 26 in the direction of arrow 27 into a vertically inclined hopper portion 100. As seen in Figure 6, vertical hopper would receive the waste material from the lower auger 24 into an upper portion 102. There would be included a rotatable panel 104 attached to a counterweight 106. When the buildup of the waste material onto plate 104 would reach a certain point, it would overcome the weight of the counterweight 106 and allow the material to dump from the upper portion 102 into an intermediate portion 105 of the vertical hopper. There the material would encounter yet another dumping plate 104(a) and again an additional counterweight 106 where this process would repeat itself and in the material contained in the intermediate portion 105, would overcome the weight of the counterweight. It would then be dumped into the very lower portion 108 of the vertical hopper and vents into the mill 30. The system of counterweights as heretofore described would serve as a means for assuring that the movement of the waste material from the hopper 24 into the mill 30 would be under a controlled movement so that the waste material would not be dumped at such a rate so as to clog the mill 30 during the operation.

In this system, there is a unique feature in its treatment process. A company's system would limit the number of people exposed to the waste material prior to treatment. The process to destroy and sterilize waste is safe and requires no toxic additives. The system would be able to convert any waste plant from class B sludge to class A material. Additionally, there is a significant reduction in the volume of sludge resulting in a dry powder. There have been numerous articles on the ability to utilize this dry powder in commercial applications, such as fertilizer. This process will further utilize the proprietary dewatering ionic acceleration energy cells as well as an air drying system that would eliminate bacterial growth in municipal waste water and sludge. Any and all living elements in the material, when exposed to this technology would be killed. This process produces exceptional quality material i.e.

class A material.

An additional feature of the present invention may be the incorporation of electro cell technology. The system would use the basic applied electro kinetic energy with an enhanced cell technology and a unique DC power controller, along with electro-chemical enhancement technologies, to induce a large variable remediation treatment. Electro remediation (ER) is a developing technology for the removal of heavy metals and radionuclides. The application of direct current in a porous medium leads to two transport phenomena, ionic species in the water solution which will migrate to the oppositely charged electrode (electromigration), and accompanying this migration, a bulk flow of solution induced usually toward the cathode (electro-osmosis). The combination of these two transport phenomena lead to a movement of contaminant ions towards one of the other electrodes. The direction and rate of movement of an ionic species will depend on its charge, both in magnitude and polarity as well as the magnitude of the induced flow velocity - non ionic species will be transported along with the induced water flow.

Figures 7-10 illustrate the preferred embodiment of an reaction chamber 110 which would be utilized in the electro-cell portion of the present invention. As illustrated, chamber 10 would be in effect, a rectangular chamber having a pair of side walls 112 and a pair of end walls 114 to define a chamber space 116 therein. The chamber would be fabricated of a material of a metal type of material and would stand off the ground via legs 118 and would have a V-shaped bottom 120 so as any material precipitated from the chamber would collect in the bottom portion 122 of the chamber. The chamber would have a first overall chamber space 124, a second chamber space 126 with spaces 124, 126 provided by a pair of baffles 128, 130, with a flow space 132 therebetween. As further illustrated, there is a first anode plate 134 on a first end 114 of the chamber and a second cathode plate 136 on the second end 114 of the chamber. Each of the anode and cathode plates would be supplied with power from an off-site power supply unit as seen in Figure 9, labeled as 140, having a first power line 142 to the cathode plate 136 and a second line 144 to the anode plate 134. This would result in a positive charge being placed on the anode plate and a negative charge being placed on the cathode plate.

As further illustrated in Figure 9, there is illustrated a cover 150 which could

be placed onto the upper end of chamber 110 so as to make it a closed chamber during the process. As seen further in Figure 9, the contaminated waste solution 152 would be introduced via a port 154 located in a central area of the wall of the cover 150 in order to introduce the fluid waste into the chamber 110. The waste material would then become a charged material and the charged material beginning to flow in the direction of arrows 156 toward the anode plate 134. During this migration, the material would begin to precipitate out into the collection area 122 whereby there is incorporated a plurality of collection lines 160 so that the heavy waste material could be precipitated out and flow out of the system in the direction of arrow 162. It is through this ion exchange which would take place during this process would accomplish a number of things, including a removal of metals, oil/water recovery, the killing of bacteria, odor control, sterilization, suspended solids removal, reduction in polymer usage, and would produce a drier cake in the bio-sludge. Further, electro processing extracts heavy material radionuclides, and other inorganic contaminants below their solubility limits. During testing, the technology has removed arsenic, benzene, cadmium, chromium, copper, ethylbenzene, lead, nickel, phenol, trichloroethylene, toluene, xylene, and zinc from soils. In the ionic waste water treatment portion of the present invention, the waste water would reclaim such things as anaerobic digesters, aerobic digesters, waste waters, industrial storm water runoff, sludges, and it would also remove metals and organic compounds and agricultural wastes.

Having discussed the entire system of the present invention, including the electro cell chamber component therein, reference is made to Figure 3 where there is illustrated the system of the present invention used in the context of a municipal waste plant. As seen in Figure 3, there is illustrated a municipal waste plant digester 200 which would feed its product through a flowline 202 into the electro cell chamber 110 of the type as described herein. The electro cell chamber 110 would move the product into a dewatering unit 112 where then it would be delivered into a centrifuge or bell press 114 with the fluid flowing separately through line 116. The solid was from centrifuge or bell press 114 would flow via line 118 into a dryer 120 where the dried product 124 would be collected for storage or disposal.

Additional information about the present invention can be found in the

attached pages of handwritten text numbered Page 1 through Page 8.

All measurements disclosed herein are at standard temperature and pressure, at sea level on Earth, unless indicated otherwise. All materials used or intended to be used in a human being are biocompatible, unless indicated otherwise.

The foregoing embodiments are presented by way of example only; the scope of the present invention is to be limited only by the following claims.

Method of and Apparatus for comminuting material, drying and grinding.

This invention relates to a method of and apparatus for comminuting material, which results in the disintegration and the drying and killing of viruses and deadly bacteria in seconds. By eleminating moisture in Bio waste from 80% moisture to less than 5%, the overall volume of sludge by a factor of 5 to 1 reduction. This system is also being tested to produce organic fertilizer.

Drawing number 1 fig shows Two double Venturi's which speeds up the air spead and helps the drying and grinding process to facilitate the process even faster.

The feed Auger is 20 ft long for greater retention time. Our Auger has a double pipe lining so the sludge is heated with indirect heat to start the process, then once the sludge is in the Mill it uses direct heat on finished product.

The mill chamber has no moving parts, the air flows over the inverted cone thus helping to lift the air in a spiral upward motion and helps start the air in rotation clockwise.

Then the air and product are lifted thru the chamber passing thru the double Venturies which Mixes the hot air and finishes the drying and grinding process on its own self.

Summary of inventions:
and differences

Casendes: Patent number 5,850,977

1) This device has a drive shaft right thru the entire length of its mills with paddles on it driven by a motor.

Ours has no moving parts at all

2) This system is designed to grind Coal, limestone and dolomite

Ours is to dry sludges with 80% moisture or more to less than 5% moisture and also make and blend organic fertilizer as well as dry and mix cattle feed.

3) This device the particles are communicated by the successive action of rotors and screens.

Our system uses only very fast air speeds and a series of multiyble venturies to dry and grind the particles.

Summary of inventions

Csenders Patent number 5,695,130

1) This device employs rotors and screens to break up the coal and to create a fluidized bed with low pressure.

Our system employs no moving parts and uses a vaccum in the Auger (feeder) mixing chamber and very high pressure in the mill chamber

2) This device is being used and invented for Coal and limestone. To reduce the moisture content from 15% to 5% moisture and grind the coal into smaller particles.

Our system is designed for reduction of Bio sludges and Bio waste. To dry sludges from 80% to less than 5% and eleminate virus and bacteria growth to go from a class B sludge to class A. And also to make organic fert. and Cattle feed.

3) This device operates at a low static pressures up to 15" water Column.

Our system generates over 100,000 CFMs and and operates at high static pressures and also produces over 46" water column and greater.

Summary of indentions.

Williams Patent number 5,839.673

1) This device uses a bag house
our system reuses its hot air, only less than 10% of its air goes thru the wet air scubber.

2) This device has a temperature range of 170°F to 190°F it reduces moisture from 15% to 5%
Our system temperature range is 150°F to 1400°F it reduces moisture levels from 80% or greater to 5% or less on Bio sludges

3) This device uses its hot gases to keep the baghouse hot and dry
Our system reintroduces its hot geses back into the system in a closed loop and help burn off any volatiles in the air stream. We reuse the heated air to reduce operating cost by 70%. The Aveage per Ton cost to dry sludge with 80% moisture is ave $300 per/Ton.

4) This device uses moving part in its mill.
Our process has no moving parts in our air stream.

5) This device states in its patent that this is used for pulvering coal to supply coal burning boilers

Our system is used on Bio waste sludges to eleminate bacterie and virus and reduce the over all volume of sludge by a factor of 5 to 1, also used for organic fertilizer and make cattle feed. This system was designed to kill harmful bacteria and deadly vireuses in seconds.

Summary of inventions:

Kim: Patent No# 4,932,594

This device was designed for the coal industry.

1) This device is used for Pulverizing coal
Our system is used for sludge drying mixing also for making cattle feed and fertilizer.

2) This device is used to grind coal to burn in boilers its grind lumps of crushed coal with moisture levels of 15% to 5%.
Our system takes Bio sludges with 80% moisture or greater and reduces it to 97% dry Kills Viruses and deadly bacteria in seconds.

3) This device also has internal moving parts, such as rotors, screens, paddles etc.
Our system does not have any internal moving parts. We use dampers to control air flow none of these devices uses dampers. Also our system uses a programable logic controller. This computer measures Temperature, volumes, air speed, and humidity of the air stream. They are controlled by a computer at our base office, no matter where the systems are located, just as long as we can hook up a phone line to it.

4) This device uses aspirators and injectors our system has none of these.

How it works:

The RAM AIR Dryer is a closed loop hot air sludge dryer. The heat is provided by a high efficiency one million BTU capability propane burner system that heats the closed loop air to temperatures ranging from 150°F to 500°F. The air in the closed loop system, after initial start up, provides the necessary air to maintain combustion. By introducing wet sludge by way of an inlet hopper and conveying screw auger into the heated air at cyclonic air speeds up to 122.25 ft per sec, the water in the sludge is transformed directly from a liquid to a gases state. The released oxygen is used to sustain combustion and create a reburn of any existing combustable gases in the burner tube section. The hydrogen and the other existing combustion gases are also carried out with the removal of the solids. Because the entire closed loop system operates on a negative pressure (vaccum) the emissions are minimum the only out side air comming into the system are from four (4) Two inch holes which are close..able visual inspection ports for the burner system. This is a Two Ton per hour demonstration unit.

CLAIMS

1. A system for treating waste materials, comprising:

a. a hopper for receiving the waste materials

b. a mill for receiving the waste materials from the hopper;

c. means for introducing a flow of hot air under pressure into the mill for drying and fluidizing the waste material as the waste material is reduced in size by the mill;

d. a cyclone for receiving the substantially dry, fluidized waste material so that solid particles of waste material may be recovered out of the cyclone;

e. means for reintroducing the air from the cyclone into the flow of hot air under pressure into the mill.

2. The system in claim 1, further comprising an auger system for conveying the waste material from the hopper to the mill.

3. The system in claim 2, wherein the auger system further comprises a first auger positioned at the lower end of the hopper for receiving the waste material from the hopper and a second auger for conveying the waste material into the mill.

4. The system in claim 3, wherein the second auger further comprises a means for heating the auger so that the material is heated to approximately 1000 degrees F. while it is being conveyed to the mill.

5. The system in claim 1, further comprising a grinder for grinding the larger waste products into smaller portions for conveying same into the mill.

6. The system in claim 1, further comprising an electro-cell chamber for receiving waste contained in liquid, applying an electrical charge to the waste particles, so that the waste particles can be separated from the liquid portion of the waste stream and disposed of.

7. The system in claim 1, wherein the temperature within the mill is

around 250 to 300 degrees F.

8. The system in claim 1, wherein the means for introducing hot air into the mill comprises a heater for heating the air, and a fan for conveying the heated air under pressure into the mill.

9. The system in claim 1, wherein the means for reintroducing the air from the cyclone in the hot air stream comprises a flow line interconnecting a point between the heater and the fan, so that the air is sucked into the heated air flowing into the mill.

10. A process for treating waste materials, comprising the following steps:

a. introducing waste materials into a hopper;

b. conveying the waste materials from the hopper into a mill;

c. reducing the size of the waste material into particles in the mill;

d. introducing a flow of hot air under pressure into the mill for drying and fluidizing the waste material as the waste material is reduced in size by the mill;

d. conveying the substantially dry, fluidized waste material into a cyclone;

e. separating the solid particles of waste material from the heated air;

f. recovering the waste material out of the cyclone; and

e. reintroducing the air from the cyclone into the flow of hot air under pressure into the mill.

11. The process in claim 10, wherein the waste is conveyed from the hopper to the mill via an auger system.

12. The system in claim 10, wherein the auger system further comprises a first auger positioned at the lower end of the hopper for receiving the waste material from the hopper and a second auger for conveying the waste material into the mill.

13. The system in claim 12, wherein the second auger further comprises a means for heating the auger so that the material is heated to approximately 1000 degrees F. while it is being conveyed to the mill.

14. The system in claim 10, further comprising the step of grinding the larger waste products into smaller portions for conveying same into the mill.

15. The system in claim 10, further comprising the step of flowing waste contained in a liquid phase through an electro-cell chamber and applying an electrical charge to the waste particles, so that the waste particles can be separated from the liquid portion of the waste stream and disposed of.

16. The system in claim 10, wherein the temperature within the mill is around 250 to 300 degrees F.

17. The system in claim 10, wherein the means for introducing hot air into the mill comprises a heater for heating the air, and a fan for conveying the heated air under pressure into the mill.

18. The system in claim 10, wherein the means for reintroducing the air from the cyclone in the hot air stream comprises a flow line interconnecting a point between the heater and the fan, so that the air is sucked into the heated air flowing into the mill.

19. A process for treating waste materials, comprising the following steps:

a. introducing waste materials into a mill;

c. reducing the size of the waste material into particles in the mill;

d. introducing a flow of hot air under pressure into the mill for drying and fluidizing the waste material as the waste material is reduced in size by the mill;

e. separating the solid particles of waste material from the heated

air;

f. recovering and disposing of the dried waste material; and

g. reintroducing the separated heated air into the flow of hot air under pressure into the mill.

20. The process in claim 19, further comprising the step of flowing waste contained in a liquid phase through an electro-cell chamber and applying an electrical charge to the waste particles, so that the waste particles can be separated from the liquid portion of the waste stream and disposed of.

21. The process in claim 19, further comprising the step of grinding the larger waste products into smaller portions for introducing same into the mill.

22. The invention substantially as shown and described herein.

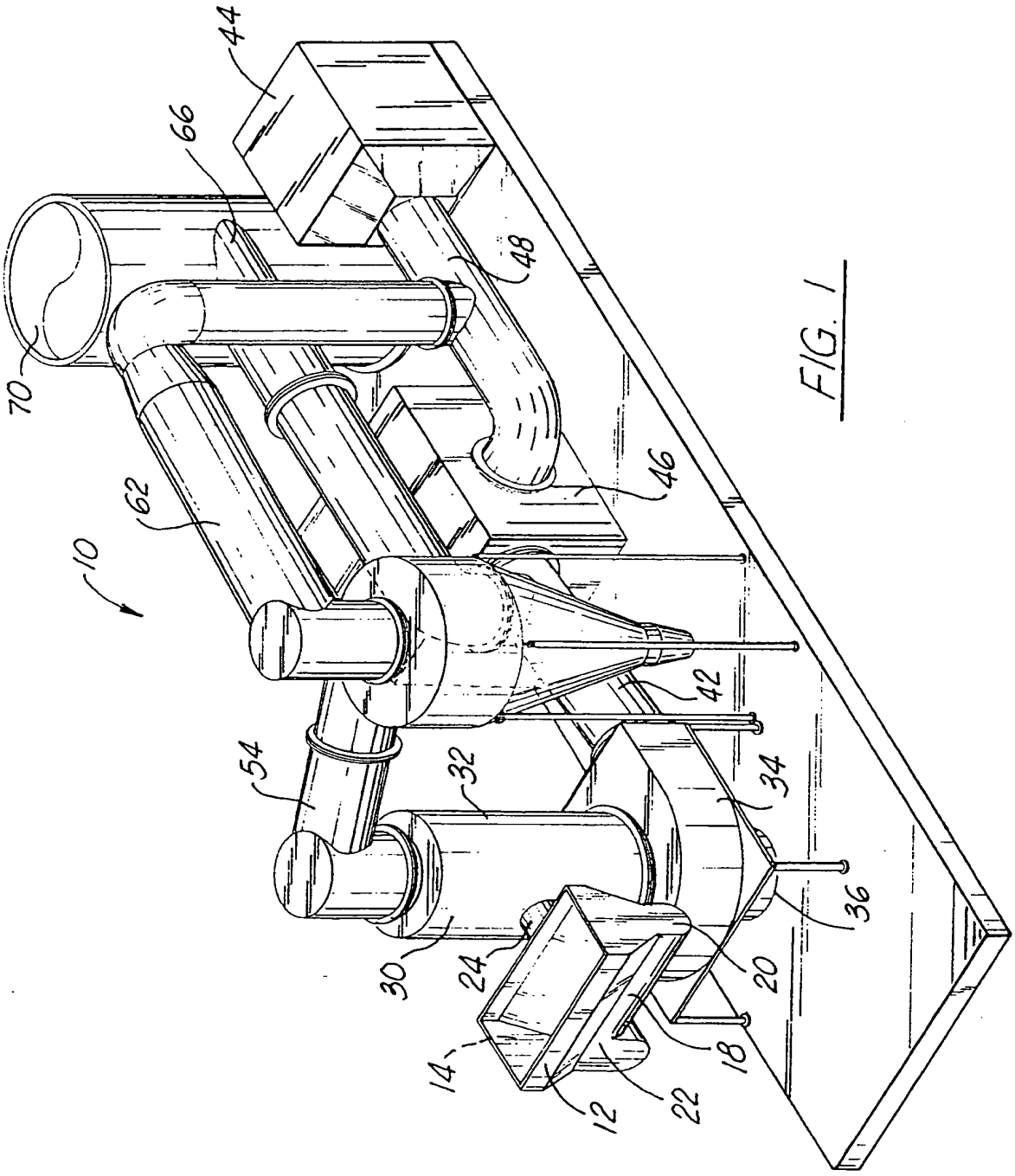

FIG. 1

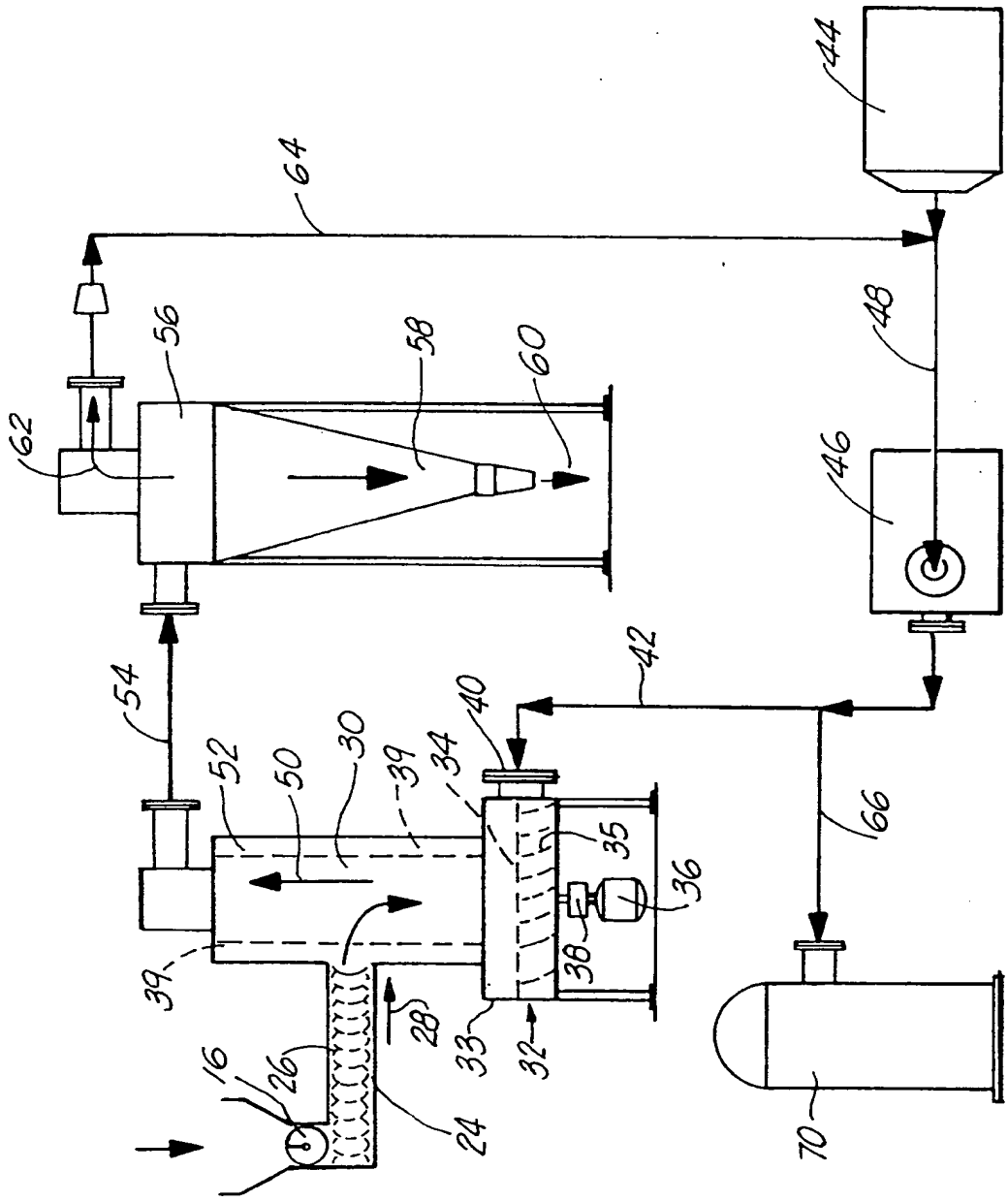
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FIG. 2

3/12

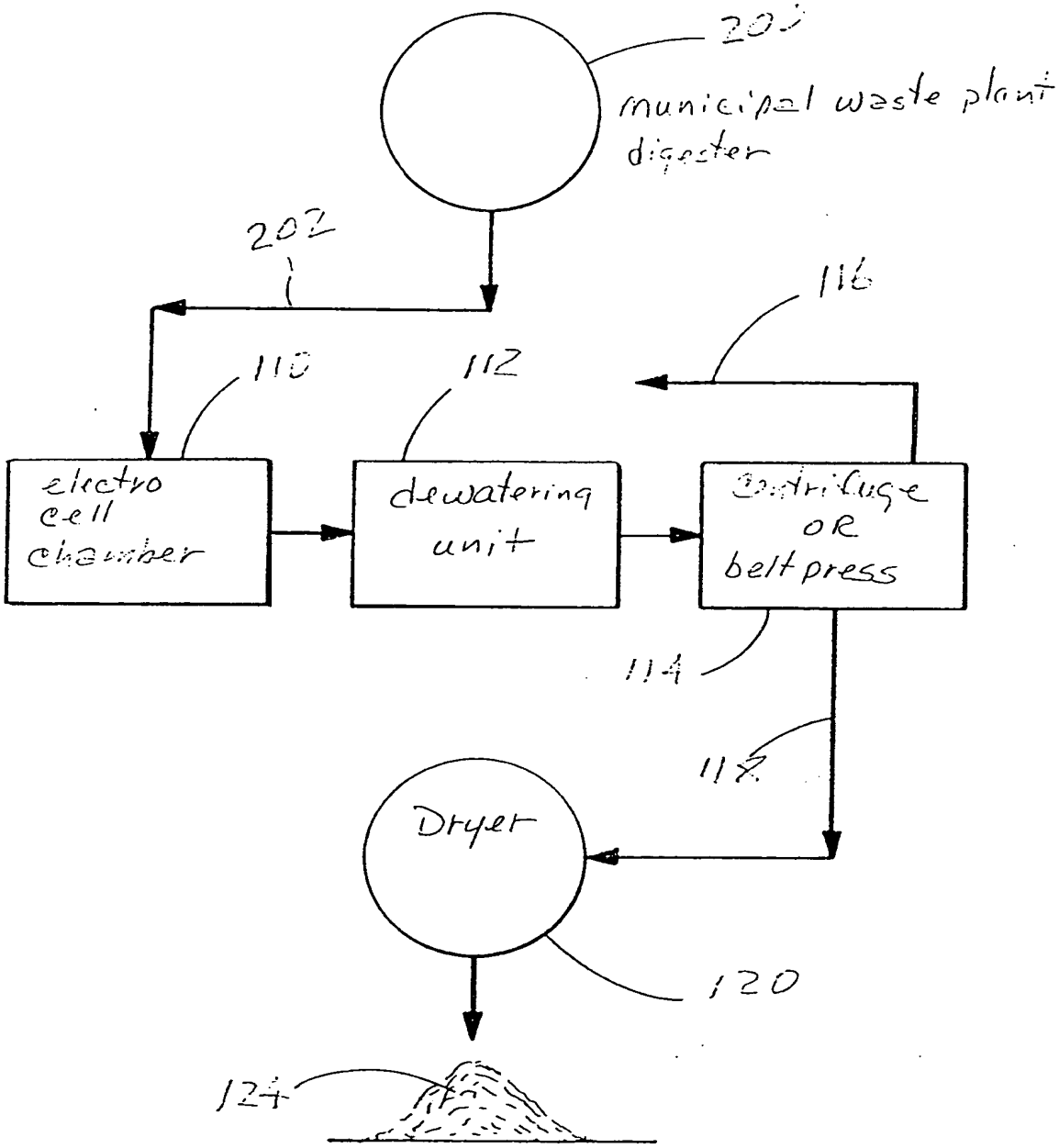

municipal waste plant digester
202
116
110
112
electro cell chamber
dewatering unit
centrifuge OR belt press
114
118
Dryer
120
124

FIG. 3

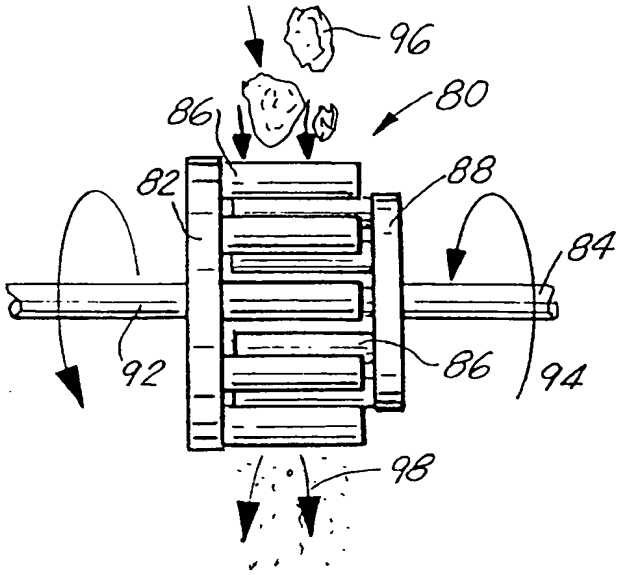


FIG. 4

FIG. 6

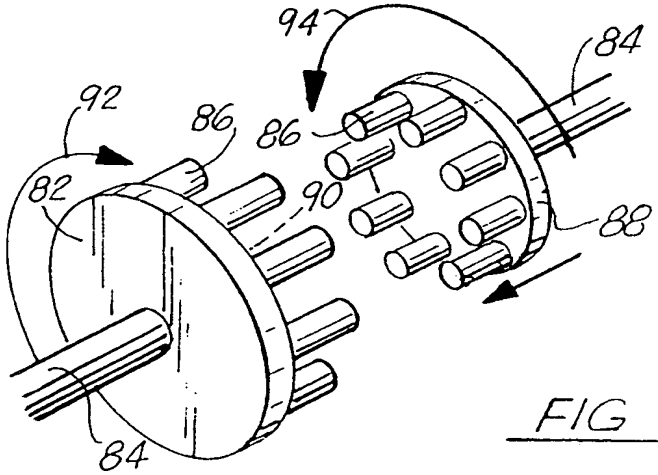
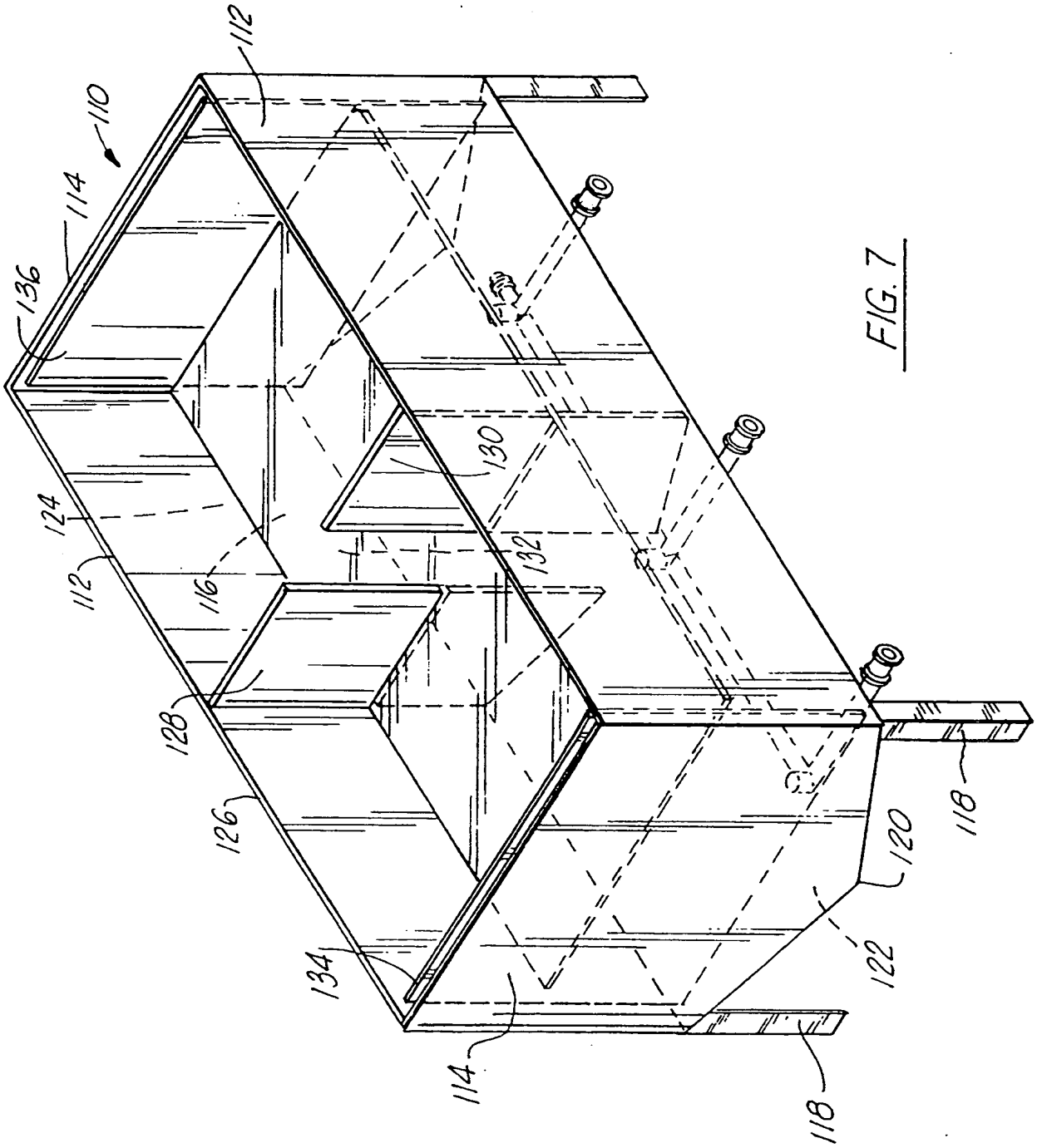


FIG 5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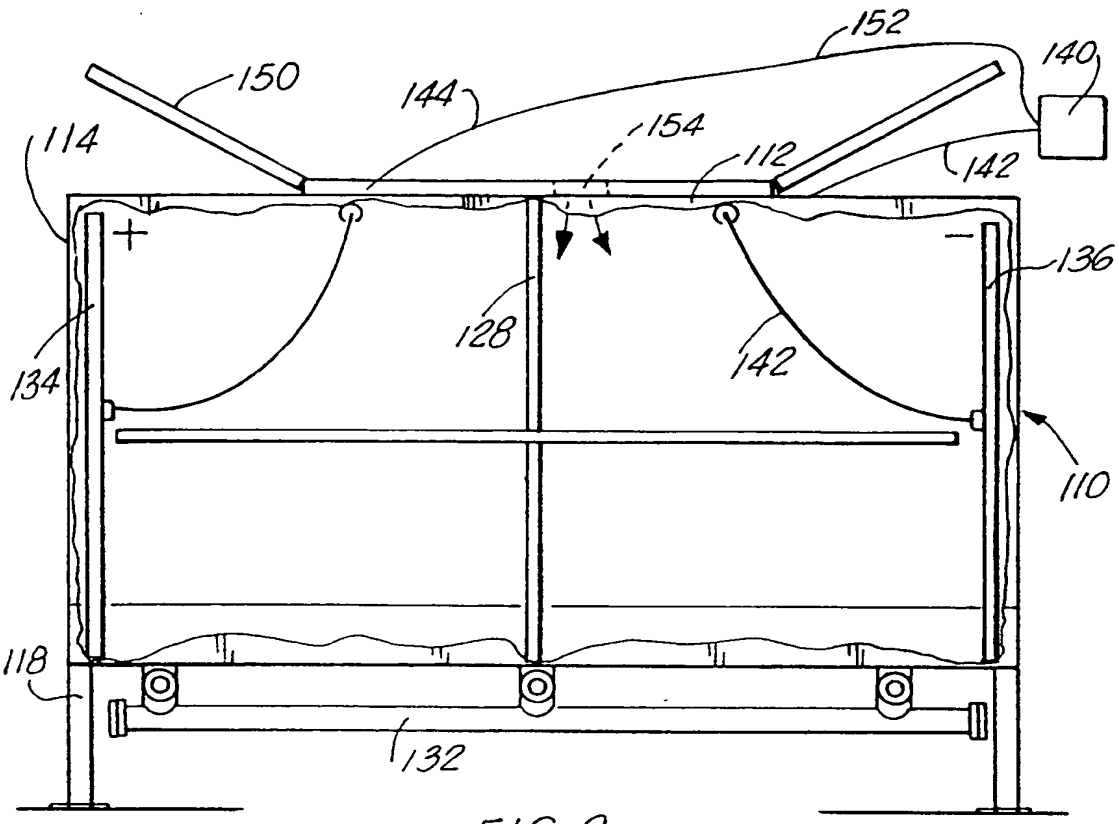
118

FIG. 7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118
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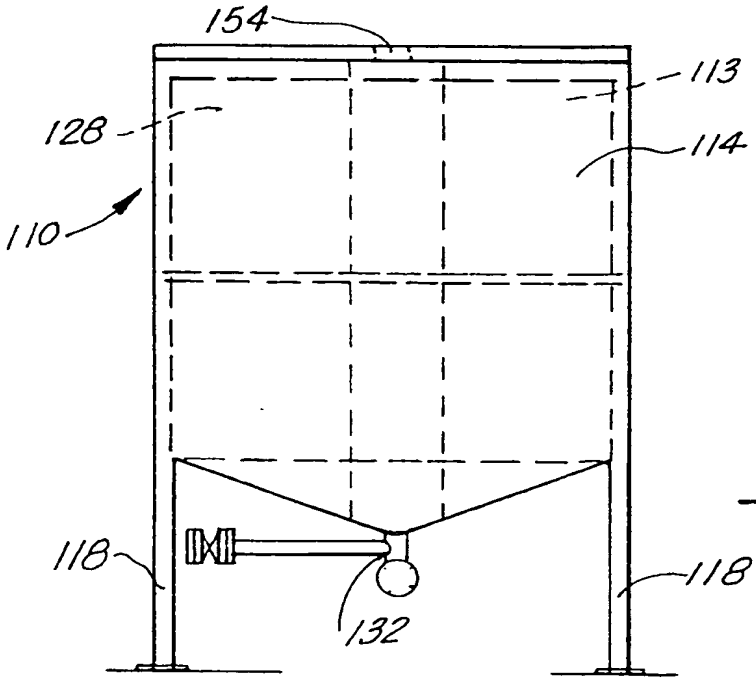
FIG. 9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113
128
114
110
118
118
132

FIG. 8

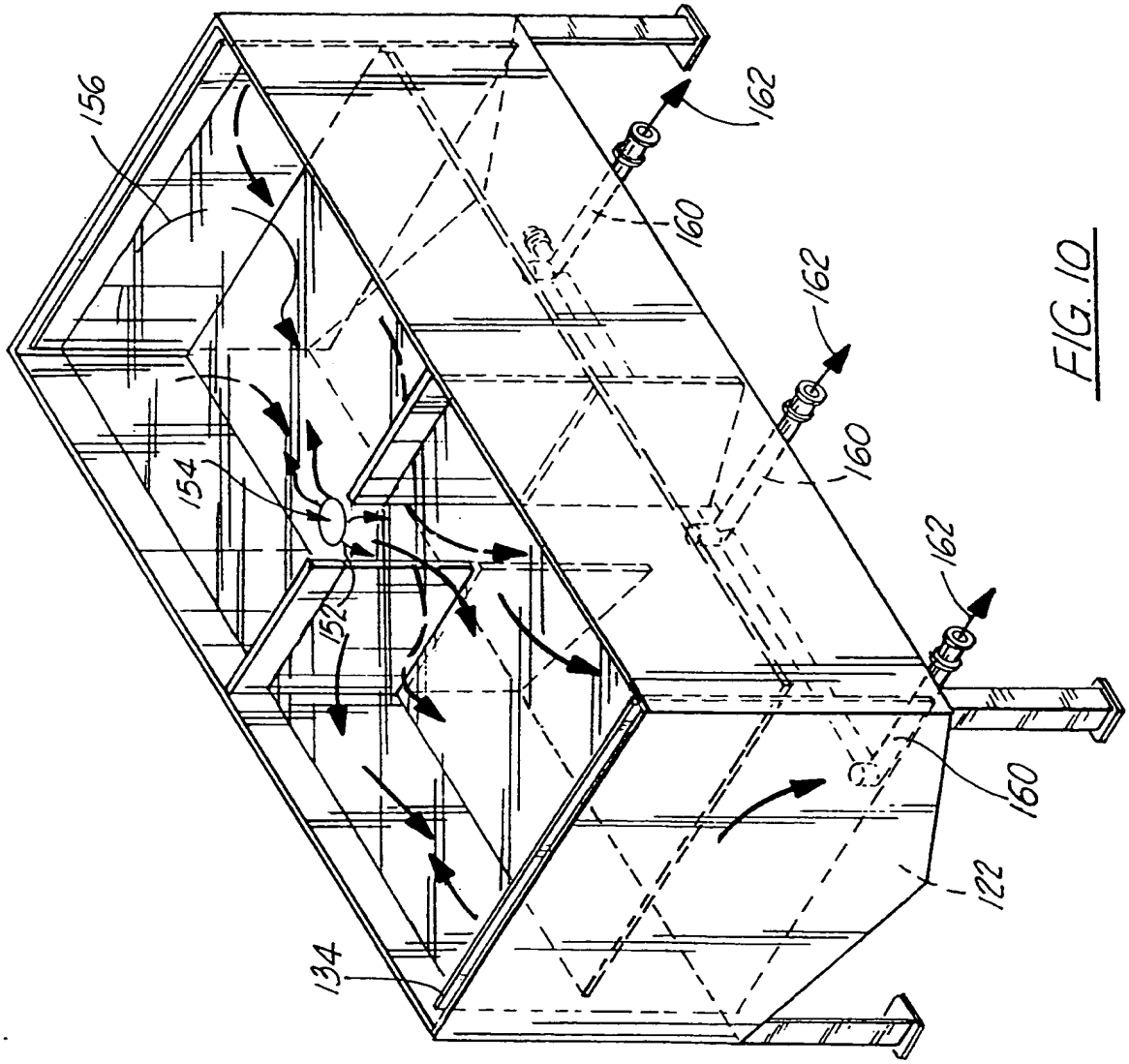

FIG. 10

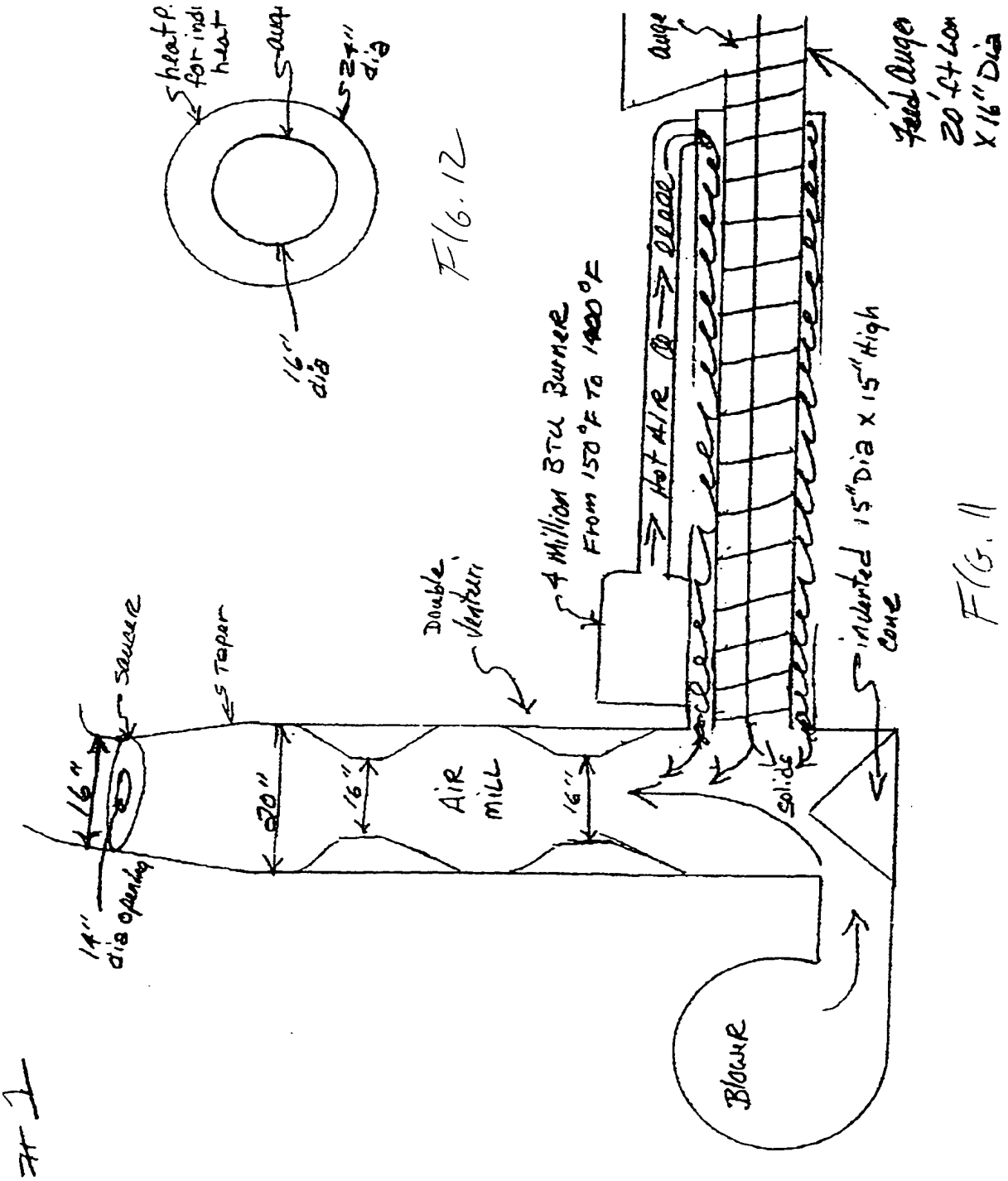

FIG. 1

FIG. 12

FIG. 11

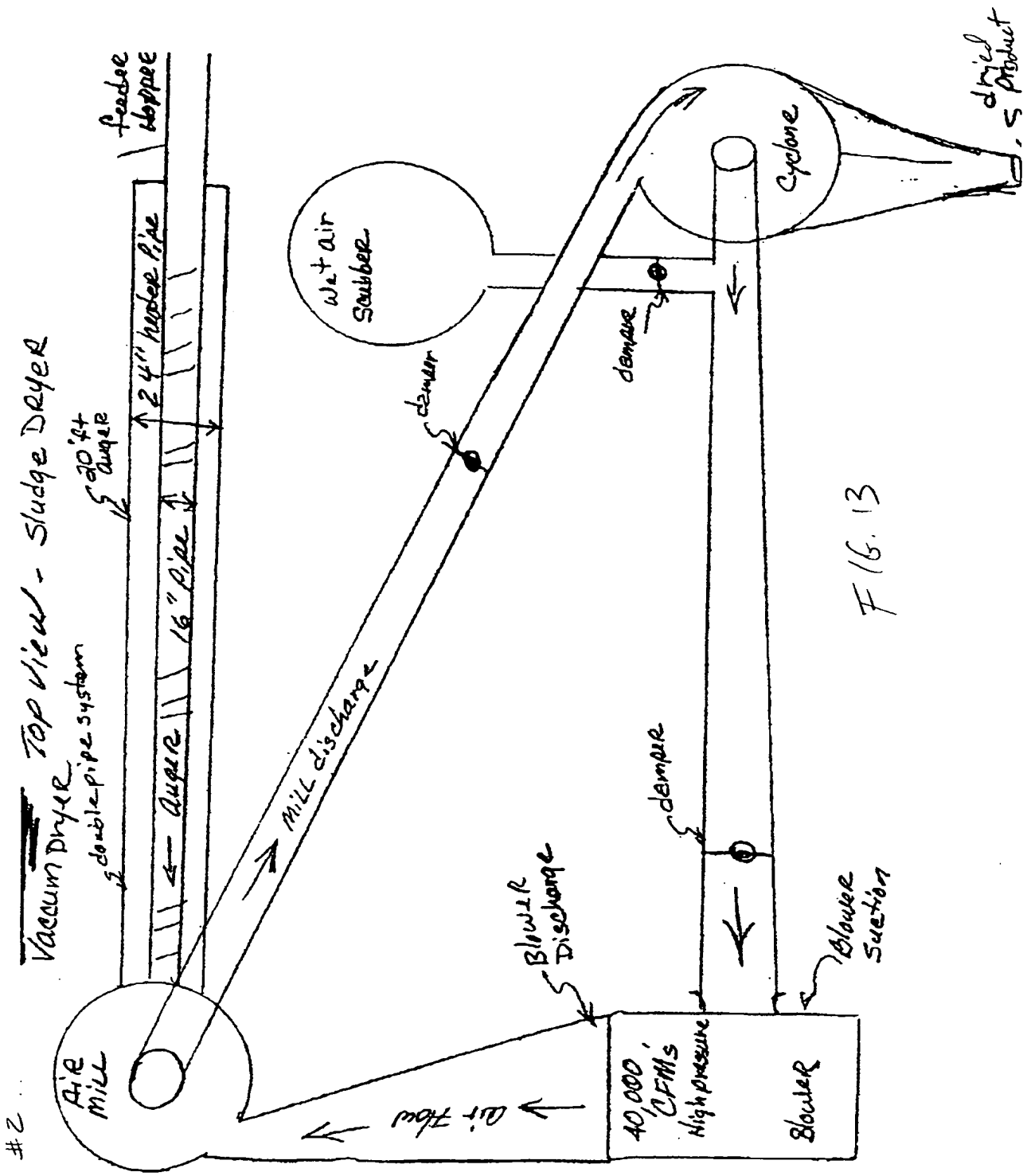
Vacuum Dryer Top view - Sludge Dryer
#2
Air mill
double-pipe system
40' ft auger
24" hopper pipe
16" pipe
Auger
feedoe hoppee
Mill discharge
damper
Wet air Scrubber
damper
Cyclone
dried product
damper
Blower Discharge
Blower suction
40,000 CFMs High pressure
Blower
Air flow

FIG. 13

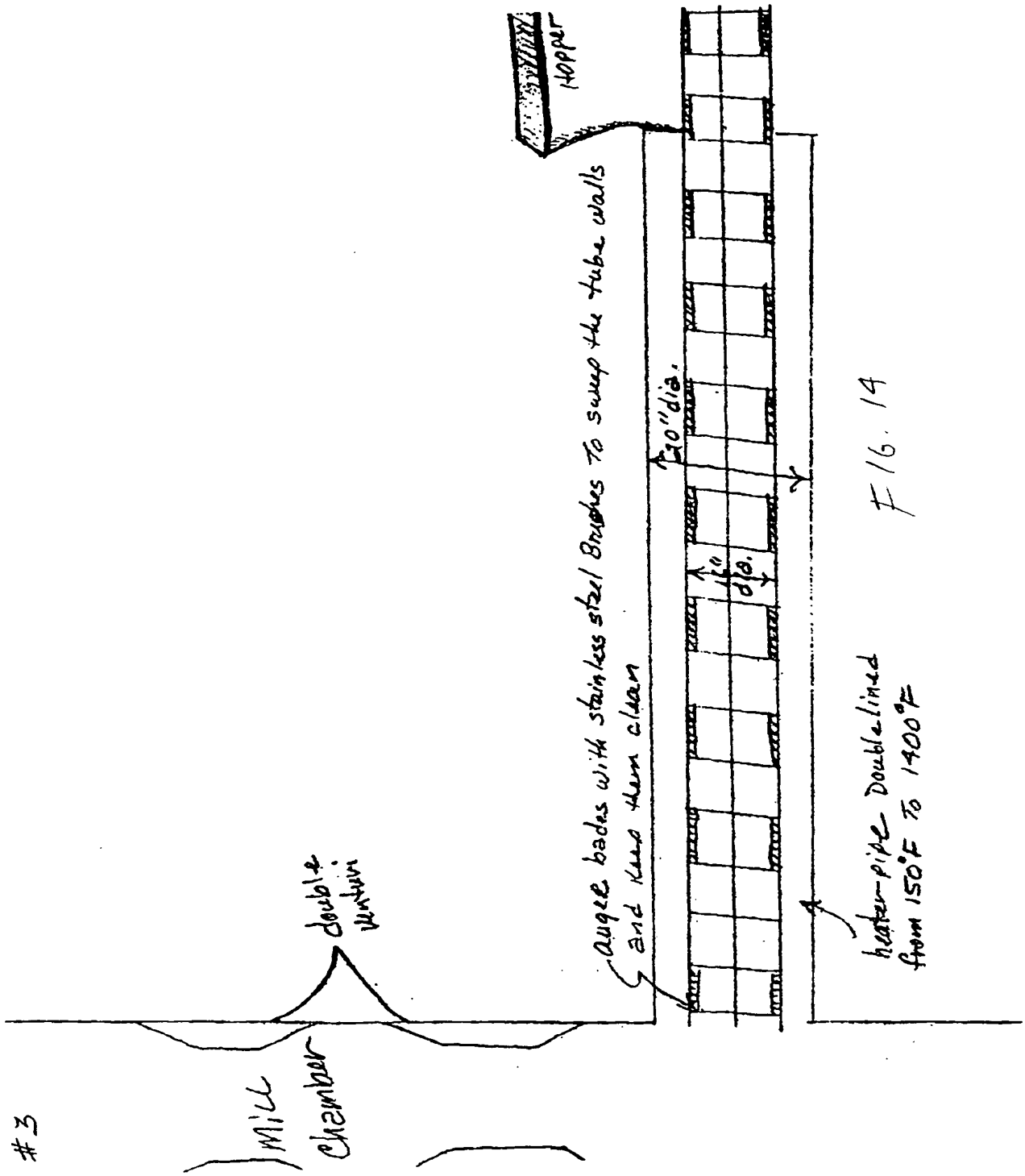
#3
Mill
Chamber
double
Auger
Auger blades with stainless steel Brushes To sweep the tube walls
and keep them clean
20" dia.
12" dia.
hopper
heater-pipe Doublelined
from 150°F To 1400°F

FIG. 14

Ram vacuum Dryer

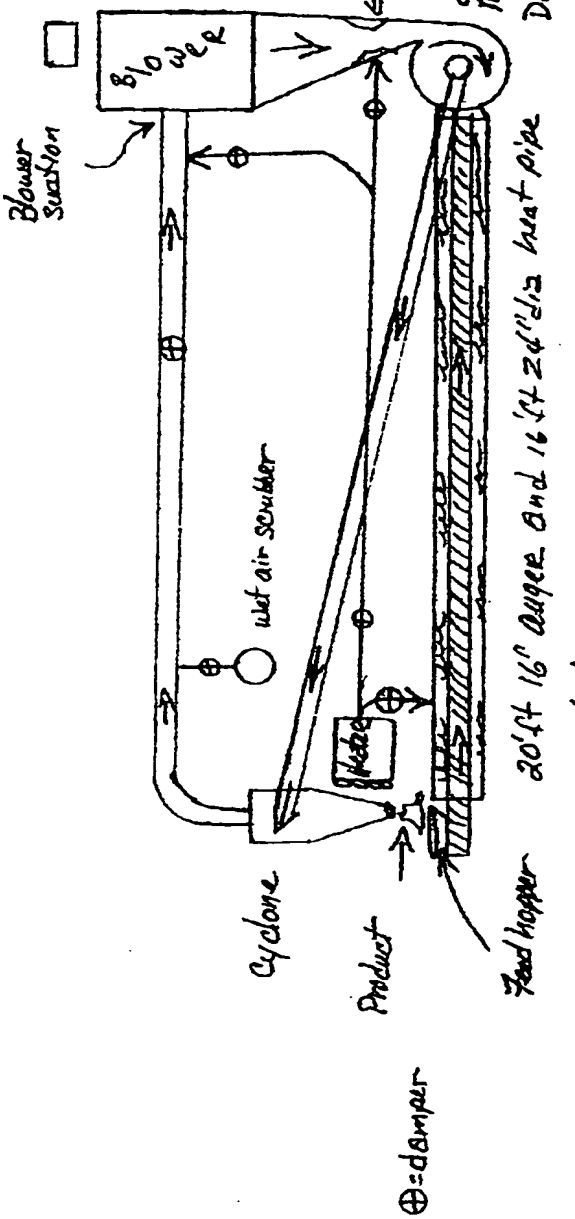

FIG. 15

(RAM) Rotary Air Mill

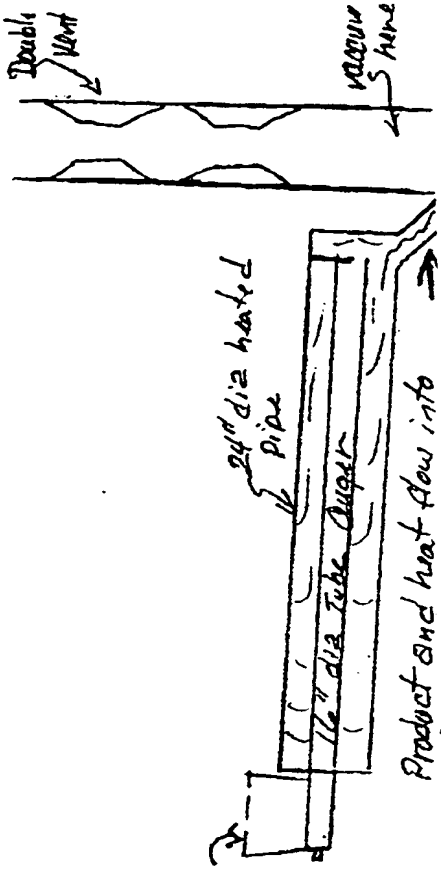

FIG. 16

#4

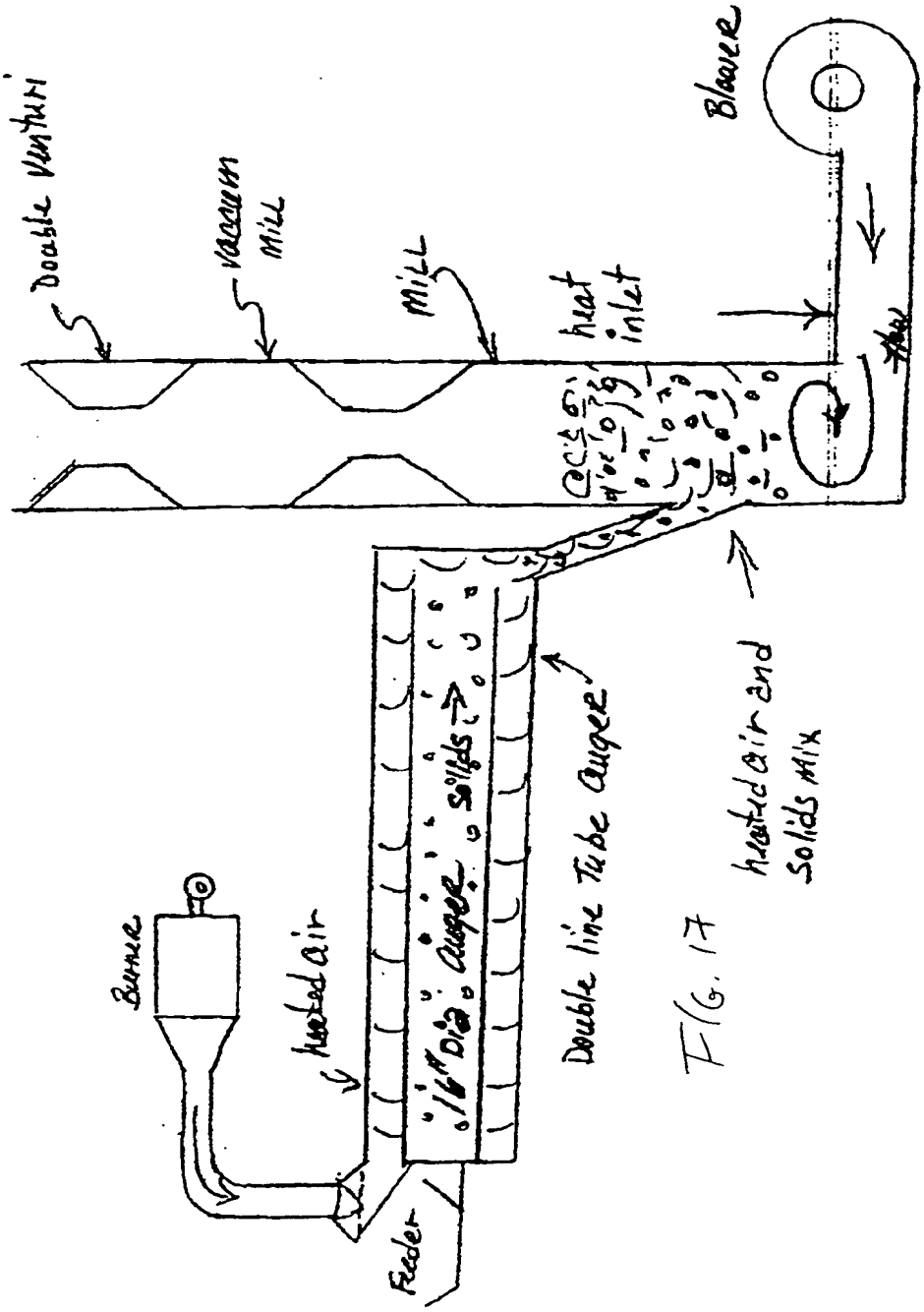
Double Venturi
vacuum Mill
Mill
heat inlet
Blower
Burner
heated air
Solids
Double line Tube Auger
heated air and solids mix
Feeder

FIG. 17

#5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/25530

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :B02C 23/08
US CL : 241/18, 48

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 241/48, 79.1, 57, 65, 18, 23, 152.2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 5,839,673 A ***(WILLIAMS)*** 24 November 1998, see entire document	1, 8, 10, 16, 17,19,22 --- 2-7, 9, 11-15 18,20,21
Y	US 5,850,977 A **(CSENDES)** 22 December 22, 1998, see entire document	2-4,11-13

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 15 NOVEMBER 2000	Date of mailing of the international search report 28 DEC 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer MARK ROSENBAUM Telephone No. (703) 308-1788

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Form PCT/ISA/210 (second sheet) (July 1998)*